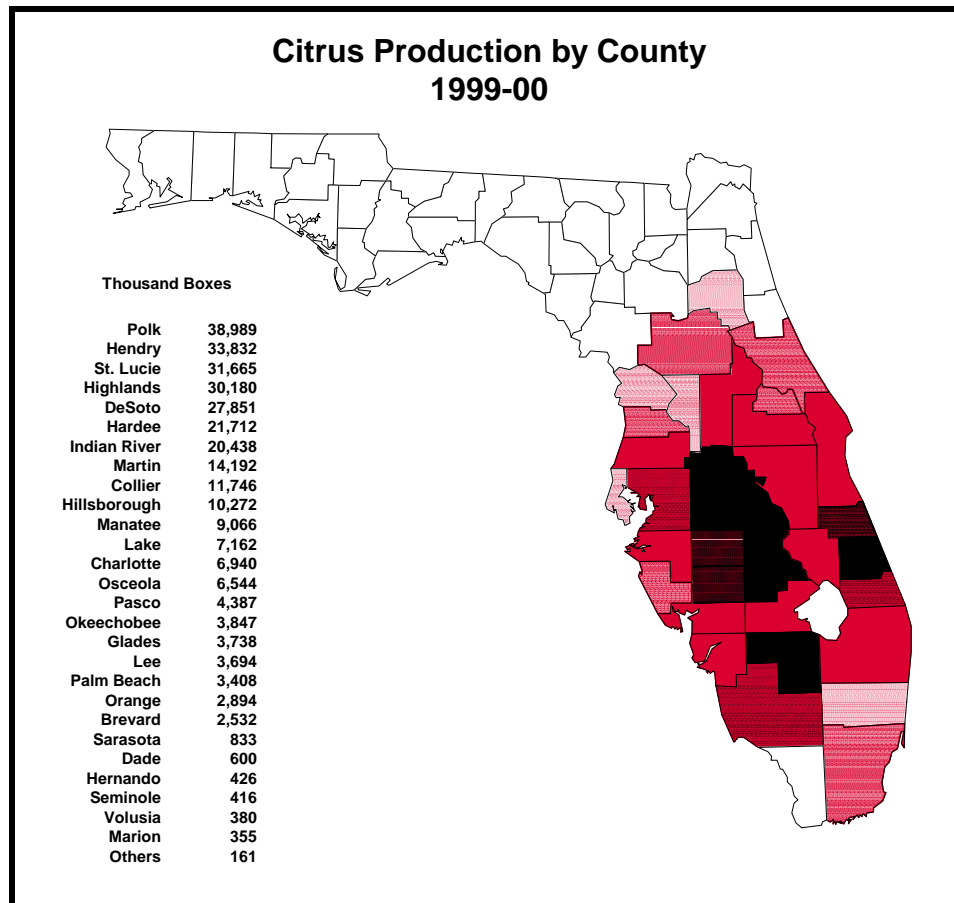


FORECASTING FLORIDA'S CITRUS PRODUCTION



FLORIDA'S CITRUS CROP STATISTICS

The Florida Agricultural Statistics Service is a cooperative agency of the United States Department of Agriculture, the Florida Department of Agriculture, and the University of Florida with the responsibility for gathering and reporting Florida's agricultural statistics. Major crop and livestock statistics are reported with various statistical methods used to prepare the information released. This report will deal only with forecasting citrus crop production.

U. S. CITRUS PRODUCTION

For many years Florida has been the nation's dominant state in production of citrus. During the last decade nearly three quarters of all U.S. citrus was grown in Florida.

Production of U.S. Citrus by States					
Season	FL ^{1/}	CA	TX	AZ	U.S. total
Thousand tons					
1990-91	9,127	1,837	0	321	11,285
1991-92	8,510	3,522	4	416	12,452
1992-93	11,175	3,662	97	340	15,274
1993-94	10,484	3,569	144	364	14,561
1994-95	12,054	3,267	230	248	15,799
1995-96	11,815	3,342	222	333	15,712
1996-97	13,156	3,632	273	210	17,271
1997-98	13,583	3,744	256	187	17,770
1998-99	10,827	2,266	305	235	13,633
1999-00	13,305	3,579	311	208	17,403

^{1/} Does not include lemons. K-Early Citrus Fruit not included prior to 1992-93. Fallglo tangerines not included prior to 1993-94.

FLORIDA'S OBJECTIVE CITRUS FORECAST

Advance knowledge of crop size permits early decisions for planning operations, marketing, and policy making, which are especially important to a crop which is harvested over several months and sold year round. The U.S. Department of Agriculture first made forecasts of Florida citrus production in 1918, based on survey opinions of crop observers and statisticians. The need for greater accuracy in these forecasts intensified as Florida's production increased. Florida's participation in world markets underlines the need for comprehensive and accurate information to successfully compete in these markets.

The interest in a statistically accurate forecast has led to the current system based on objective data including an early season limb count survey to establish actual fruit set, supplemented with monthly in-season measurements of fruit size and observations of fruit dropage. This system of the forecasts and estimates is possible through an industry supported per-box assessment on all Florida production. The resulting trust fund is used to collect much of the objective survey data for the USDA forecast and estimates.

Florida's Citrus Production by Seasons				
Season	Oranges	Grapefruit	Others	Total
Million boxes				
1990-91	151.6	45.1	9.0	205.7
1991-92	139.8	42.4	9.6	191.8
1992-93	186.6	55.1	9.8	251.5
1993-94	174.4	51.1	10.3	235.8
1994-95	205.5	55.7	9.8	271.0
1995-96	203.3	52.4	9.7	265.4
1996-97	226.2	55.8	13.3	295.3
1997-98	244.0	49.6	10.9	304.5
1998-99	186.0	47.1	10.1	243.2
1999-00	233.0	53.4	12.0	298.4

COMMERCIAL TREE CENSUS

The commercial tree census, done every two years, provides a complete record of trees and acreage by counties for each citrus type and variety, by year planted. In addition to its use for decisions on planting and future planning, the census provides a sampling frame for the objective forecasting surveys--the statistical sample of groves is drawn from the census records. Thus, resulting estimates from the same survey data may be used with statistical confidence obtainable only with a probability sample.

The census uses aerial photographs of about 14,000 square miles of the Florida peninsula covering virtually all citrus growing areas. Photos are taken at 15,000 feet on black and white panchromatic film. The resulting exposures with a scale of 1:30,000 cover a three-mile wide swath on the ground, and the same flight lines are followed for each census. The first such photos were taken in late 1965 and used for the January 1966 census.

For that census survey, photo enlargements were obtained and every block of citrus was identified on the ground and mapped onto an enlargement. The resulting record of each planting has been updated, amended, and added to at every census since then, through the use of photo comparison and subsequent survey work in the groves.

Photo interpreters in the Orlando office use stereoscopes to compare new photos with previous photos for any changes that may have occurred in the two-year interim. Changes include new plantings, abandoned groves, pushed groves, as well as excessive vacancies or reset trees in older groves. Once these changes are noted, ground crews make on-site evaluations and record all changes in grove status. In the case of new groves, all necessary information on year set, variety, tree counts, and row spacing are obtained for the official record. When groves are found to be pushed or abandoned, the records are deleted. Approximately 1,200 photo enlargements on positive transparencies are necessary to delineate and index all the State's variety blocks. Digital planimeters are used to measure the grove areas to tenths of acres.

Florida Commercial Citrus Acreage as of January				
Survey	Oranges	Grapefruit	Others	Total
Acres				
1966	673,086	103,224	81,772	858,082
1968	713,400	119,883	97,966	931,249
1970	715,806	124,050	101,615	941,471
1972	659,418	124,142	94,459	878,019
1974	642,431	130,326	91,341	864,098
1976	628,567	137,909	85,893	852,369
1978	616,020	136,342	78,873	831,235
1980	627,174	139,944	78,165	845,283
1982	636,864	139,939	71,053	847,856
1984	573,991	134,680	52,694	761,365
1986	466,252	117,845	40,395	624,492
1988	536,737	119,606	41,586	697,929
1990	564,809	125,300	42,658	732,767
1992	608,636	135,166	47,488	791,290
1994	653,370	146,915	53,457	853,742
1996	656,598	144,416	56,673	857,687
1998	658,390	132,817	54,053	845,260
1999 ^{1/}	--	121,258	--	--
2000	665,529	118,145	48,601	832,275

^{1/} Special grapefruit survey.

OBJECTIVE SURVEY METHODS

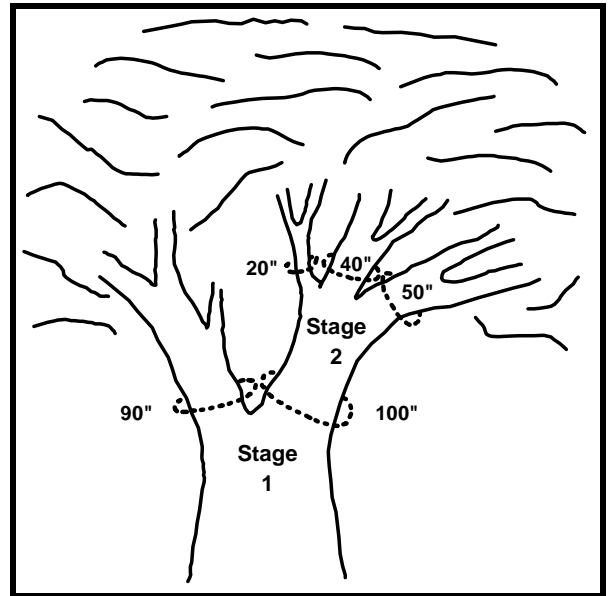
The annual citrus crop production forecast is based on estimates and projections from actual counts and measurements, avoiding observations based on opinion or judgment. These objective procedures are simple in concept but complex in planning, management for efficiency, and quality assurance. The four basic parameters used in the forecast are (1) number of bearing trees, (2) number of fruit per tree, (3) fruit size, and (4) fruit loss from droppage. The first two of these parameters have the greatest influence on the forecast. The general model incorporates the estimated total fruit (bearing trees times average fruit per tree), divided by the number of fruit projected to make a standard box at harvest (using the fruit size survey), reduced for droppage (the fraction of fruit counted at survey time but lost to droppage before it is harvested).

$$\begin{array}{rcccl} & \text{Bearing} & & \text{Fruit} & \\ & \text{Trees} & \times & \text{per Tree} & \\ \text{Production} & = & & & \times \text{Percent Remaining} \\ \text{Indicator} & & & & \text{at Harvest} \\ & & & \text{Pieces of Fruit per Box} & \end{array}$$

The sample design used to obtain each parameter stratifies the State's citrus belt into five nearly homogeneous areas and the bearing trees into five age groups. Sample groves for surveying are selected from the citrus tree inventory using probability sampling procedures. The samples are mapped on copies of aerial photo enlargements and indexed for reference. Developed during the mid-1950's, the Limb Count survey conducted from mid-to-late summer has become the basic tool for estimating the average number of fruit on Florida's citrus trees. Annually as many as 3,200 sample groves are drawn from the tree census data by type, to be representative of their population. Survey crews are then dispatched to these groves. At each sample site, two trees are chosen at random for sampling.

A sample limb representing approximately 10 percent of the bearing surface of each tree is randomly selected based on the cross sectional area measurements of limbs, starting at the trunk or scaffold and moving in successive stages up the tree. Fruit is then counted on this sample limb, with random recounts by supervisors to maintain quality control. The procedure utilizes the correlation between limb size and the fruiting ability of that limb--thus it is most efficient to sample more trees and count only a small part of each tree.

Fruit counts are then expanded by the reciprocal of the probability of selection to a total tree basis. This design results in the reliable estimates of average fruit per tree.



SIZE AND GROWTH OF FRUIT

Another important parameter in the forecast is the expected fruit size. Fruit size measurement surveys are conducted monthly from August to harvest on two trees in each of about 1,800 sample groves.

Circumference calipers, which have proven to be the most sensitive tool to measure subtle changes in size, are used for this survey. Fruit size is projected to harvest by use of growth charts, historical relationships of current survey data to final results, and other relationships to detect similar-year growth. Fruit circumference is converted to number of fruit per box to report the forecast in boxes.

FRUIT LOSS FROM DROPPAGE

Fruit droppage is the final key factor which must be considered to develop a reliable forecast of production. This requires monthly observations of fruit loss from many sample branches. These sample branches are tagged and the fruit is counted at the same time as the Limb Count survey. Then at monthly intervals, the same branches are recounted. Cumulative fruit loss for the season and historical data from previous seasons are used to project fruit loss to harvest time.

The resulting October forecast is subject to change in later months due to weather conditions that affect fruit sizing and droppage rates.

CITRUS MATURITY AND YIELD SURVEY

Another feature of the Florida citrus forecasting program is the projected yield of frozen concentrated orange juice (FCOJ) for oranges, expressed in gallons of concentrate per box. This projection is important for fruit used in processing which is a major portion of the orange production.

Sample groves and trees remain relatively constant from year to year in order to assure the greatest continuity of data. Fruit samples are collected monthly throughout the season and tested for acid, solids, and unfinished juice. The projection of FCOJ yield per 90 pound box equivalent is based on a regression of these unadjusted maturity and yield test results to actual yields at processing plants during past seasons. The level of maturity, weather, and harvest patterns all play a substantial part in the final result.

Prior to freezes in the mid-1980's, the Florida citrus industry annually produced approximately 90 percent of the nation's supply of frozen concentrated orange juice. In recent years, more fruit has been going to fresh squeezed products.

Florida's Frozen Concentrated Orange Juice (FCOJ)

Season	Boxes used	Average yield	Product
	Thousand boxes	1/	Thousand gallons
1990-91	104,136	1.45	151,396
1991-92	93,931	1.55	145,421
1992-93	132,154	1.58	208,662
1993-94	116,248	1.57	182,231
1994-95	144,678	1.50	216,502
1995-96	132,907	1.52	202,353
1996-97	153,842	1.57	241,800
1997-98	160,865	1.58	253,734
1998-99	97,247	1.63	158,884
1999-00	134,204	1.55	207,708

^{1/} Gallons per box at 42° Brix.

OTHER SURVEYS AND STATISTICS

From the objective surveys, estimates of production by counties and boxes of fruit per tree by types and ages are reported in the preliminary Production and Value release. It is followed by the annual Citrus Summary. From the biennial tree census surveys, tree and acreage changes are shown by fruit types, counties, and year set in the preliminary Tree Census release and the Commercial Citrus Inventory. A monthly route survey is conducted during the season to estimate the percent of fruit harvested to date. Additional crop statistics are provided as the need arises. These include surveys following such disasters as hurricanes and freezes.

VALUE OF FLORIDA'S CITRUS CROP

Florida citrus production represents about one fifth of the total value of farm production in the State. Farm production value is the product of total units sold and the average price received by the producer.

Average prices received are estimated monthly for sales for fresh use and for processing, based on current sales information. These estimates are combined with sales volume to calculate a season average price. The price estimates, especially for processing, are subject to revision after the closing of cooperative pools, about one year later, since about one half of the orange crop is sold through cooperative and participation plans.

Price estimates are made and published for a 90-pound box equivalent of oranges and 85 pounds of grapefruit. The price received by growers for fruit processed is for pounds of sugar solids delivered to the processor. In recent years, over 90 percent of oranges and 50 percent of grapefruit were processed.

Prices are reported at two levels: The on-tree value of sales, which excludes the cost per box for picking and hauling the fruit to the packinghouse, and the value per box delivered to the packinghouse.

On-Tree Value of Florida's Citrus

Season	Oranges	Grapefruit	Others	Total
	Thousand dollars			
1980-81	697,231	181,155	74,964	953,350
1981-82	538,686	100,597	74,097	713,380
1982-83	718,420	77,221	81,136	876,777
1983-84	670,618	111,158	67,681	849,457
1984-85	737,923	161,356	85,541	984,820
1985-86	469,959	191,068	64,007	725,034
1986-87	624,771	248,120	68,187	941,078
1987-88	1,046,700	299,887	96,529	1,443,116
1988-89	1,086,319	243,874	99,615	1,429,808
1989-90	684,226	201,756	66,321	952,303
1990-91	892,675	255,328	88,123	1,236,126
1991-92	828,749	280,629	99,566	1,208,944
1992-93	649,713	146,432	59,667	855,812
1993-94	713,312	167,211	59,331	939,854
1994-95	767,924	116,602	63,647	948,173
1995-96	895,465	101,140	79,212	1,075,817
1996-97	801,344	88,009	71,143	960,496
1997-98	900,815	63,000	59,568	1,023,383
1998-99	900,044	111,209	88,101	1,099,354
1999-00 ^{1/}	876,662	212,311	66,043	1,155,016

^{1/} Preliminary.

FORECAST ACCURACY

Each forecast is subject to inherent sampling errors, but during recent non-freeze seasons, the average deviation from the October forecast to the final pickout has been about four percent for oranges and grapefruit.

October Forecast Versus Final Production				
Season	Oranges		Grapefruit	
	October	Final	October	Final
Million boxes				
1990-91	165.0	151.6	50.5	45.1
1991-92	136.0	139.8	42.5	42.4
1992-93	186.0	186.6	54.0	55.1
1993-94	172.0	174.4	49.0	51.1
1994-95	196.0	205.5	55.5	55.7
1995-96	202.0	203.3	54.0	52.4
1996-97	220.0	226.2	59.0	55.8
1997-98	254.0	244.0	54.0	49.6
1998-99	190.0	186.0	50.0	47.1
1999-00	211.0	233.0	50.0	53.4

FORECAST SECURITY

The citrus crop forecast is released by the USDA Agricultural Statistics Board in Washington, D.C., on or before the 12th day of the month, reflecting conditions as of the first of that month. The report is always released at 8:30 a.m., before the opening of business on the "Futures Market." This is done to permit all concerned an equal opportunity to have access and review the statistics before trading resumes.

To insure absolute security of the information, all orange survey data is summarized in restricted areas and ultimately assembled for release in the lock-up area of the National Agricultural Statistics Service. An oath of loyalty is administered to all employees of the Department and they are subject to punishment for early release of information or for reporting erroneous data.

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